

Pain Control and Parent Mental Health Among Pediatric Inpatients

Andrew Barnes, MD, MPH,^a Ashley Tollefson, BS,^b Patricia Hickey, MD,^a Jennifer Bares, BS,^b Lei Zhang, MS^c

ABSTRACT

OBJECTIVE: Pain control remains a problem for hospitalized children, with more than half experiencing ongoing pain. Pain in turn negatively affects child quality of life. To clarify the relationship between inpatient pain control and parent and child psychological factors, we tested the hypotheses that pain control is worse in the context of higher child executive function problems, lower parent mindfulness, and higher parent mental health symptoms.

METHODS: We conducted an observational study of stable pediatric inpatients' ($n = 81$; mean age = 10.5 [SD 4.7]; 55% male) nurse-recorded pain scores; physical health and executive function; and parental cognitive-affective mindfulness and mental health. Linear mixed models examined associations between these variables and changes in pain scores over time, adjusting for covariates.

RESULTS: After adjusting for child age, child gender, and parent educational status, both time ($\beta = -.23$, $P = .003$) and baseline pain ($\beta = .43$, $P < .001$) were related to pain control. After adjusting for demographics, time, and baseline pain, both parental anxiety ($\beta = .11$, $P < .001$) and depression ($\beta = .12$, $P < .001$) were significantly related to pain control.

CONCLUSIONS: Child pain control worsened with higher parent anxiety and depression. The results highlight the importance of offering mental health resources to distressed parents of hospitalized children in pain.

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Address correspondence to Andrew Barnes, MD, MPH, Developmental-Behavioral Pediatrics, Division of General Pediatrics and Adolescent Health, University of Minnesota Medical School, 717 Delaware St SE, Suite 353, Minneapolis, MN 55414. E-mail: drbarnes@umn.edu

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Dr Barnes conceptualized and designed the study, carried out preliminary analyses, and drafted the initial manuscript; Ms Tollefson, Dr Hickey, and Ms Bares acquired data and reviewed and revised the manuscript; Ms Zhang carried out data analyses and revised the manuscript; and all authors approved the final manuscript as submitted.



^aDepartment of Pediatrics and ^cClinical and Translational Science Institute, University of Minnesota Medical School, Minneapolis, Minnesota; and ^bUniversity of Minnesota Medical School, Minneapolis, Minnesota

Approximately 8% of children under age 18 are hospitalized each year.¹ During hospitalization, more than half of children experience moderate to severe pain.^{2,3} Inadequate pain control is a problem for a large proportion of these children, up to 10% of whom have pain that remains high despite interventions.^{4,5} In recent years, the wide dissemination of accurate visual analog and behavioral observation scales has improved the assessment of pain in children.⁶ Nevertheless, many children, including infants and children with communication difficulties, still remain at risk for unrecognized and undertreated pain.^{6,7} Poor pain control affects quality of life and daily functioning, particularly in the areas of school performance and attendance, sleep, and social interactions.^{3,8,9} Furthermore, undertreated pain during childhood leads to long-term changes in responses to pain and increased pain vulnerability,^{8,10} and may contribute to physical and emotional disabilities in adulthood.^{6,9} Parents and children both play important roles in the recognition and treatment of children's pain.

Children have pain-coping skills that can vary widely by sex, age, and race.⁷ These skills can also vary by individual differences in development. For example, higher levels of goal-directed cognitive-affective self-regulation (ie, executive function), such as working memory and inhibitory control, improve children's affective experiences of pain.¹¹ Parent support also influences how children cope with pain; for example, parental catastrophizing and anxiety are associated with functional abdominal pain in children.¹² Experimental models of acute pediatric pain also demonstrate that parents' expressions of anxiety contribute to children's pain, suggesting that parental responses play a key role in how children cope with painful experiences.^{13–15} Other family factors, such as overall family functioning, may not contribute directly to children's pain levels but could negatively influence how children cope with pain.^{16,17} It is also possible that the relationship between parental anxiety and child pain is indirect.^{17,13,18} Finally, although emerging evidence suggests that child and parent anxiety in the immediate postoperative period predicts children's acute and chronic pain after orthopedic surgery,^{19–21} child and parent

factors associated with pain control in general pediatric inpatient populations remain unclear.

Family and child characteristics that influence children's pain in ambulatory or orthopedic settings could play an important role in the inpatient setting. However, research to date has yet to adequately characterize the relationship between parent and child psychosocial factors and hospitalized children's pain control. To address this, we aimed to measure how pediatric inpatient pain control over an entire hospital stay relates to baseline levels of parent mindfulness, parent emotional health, and child executive function. We hypothesized that pediatric inpatients' pain control would worsen with increasing child executive function problems and parent mental health problems and would improve with higher levels of parent mindfulness, controlling for key sociodemographic covariates including children's overall health status.

METHODS

We conducted a prospective, longitudinal study of 97 children and families at the University of Minnesota Masonic Children's Hospital in Minneapolis, Minnesota. Due to the exploratory and preliminary nature of the study, sample size was based on feasibility; thus, power calculations were not performed a priori. Inclusion criteria were English-speaking parent or guardian; child aged 36 months to 17 years, 11 months at the time of enrollment; and admission for >24 hours to a University of Minnesota Masonic Children's Hospital pediatric inpatient unit for routine care of medical and surgical conditions. Children with unstable medical or surgical problems, in acute distress, or on critical care units, were not eligible for the study. Parents were enrolled in the study and completed all measures using REDCap^{22,23} as soon as possible after admission to the inpatient unit (within 1 day, and no later than 5 days, after admission). The study was approved by the University of Minnesota Institutional Review Board.

Measures: Pain

Pediatric nurses documented children's pain scores according to standard

institutional protocols from the time of subjects' arrival on the inpatient unit (0–10, via the Wong-Baker FACES scale²⁴; the Faces, Legs, Activity, Cry, and Consolability scale²⁵; or the Numeric Rating Scale²⁶). We excluded pain scores that were recorded in other settings during the hospital stay (eg, outpatient clinics, emergency departments, operating rooms and postanesthesia care units, or ICUs). We obtained all scores from the electronic medical record after children were discharged from the hospital.

Child Factors

Parents reported on their children's overall physical health using 27 items from the MacArthur Health and Behavior Questionnaire, which comprise 2 well-validated subscales, the Chronic Medical Conditions (scored as the sum of 22 possible items) and the Global Physical Health (scored as the mean of 5 items pertaining to impairments/limitations on the child due to his/her health), that are percentile-ranked and averaged into a composite scale, the Physical Health Problems Index.²⁷ Parents reported on their children's self-regulation abilities using the Global Executive Composite from the Behavior Rating Inventory of Executive Function—Parent Report (the 86-item version for ages 6–17 and the 63-item version for ages 3–5, both with items rating child behavior over the past six months such as “Needs help from an adult to stay on-task” on a 3-point scale ranging from “Never” to “Often”); higher scores indicate more child executive function problems.²⁸

Parent Factors

Parents reported on their attention, awareness, focus, and acceptance using the Cognitive and Affective Mindfulness Scale—Revised, consisting of 12 items using a 4-point response scale ranging from “Rarely” to “Almost always” (eg “I can accept things I cannot change”); higher scores indicate more mindfulness during daily situations.²⁹ Parents reported on their symptoms of anxiety during the past week using the Patient-Reported Outcomes Measurement Information System Anxiety Scale (PROMIS Anxiety 1.0), consisting of 8 items using a 5-point response scale from “Never” to “Almost always” (eg “In the past 7 days, I felt tense”);

TABLE 1 Baseline Characteristics of the Sample (*n* = 81)

Description	Mean (SD) or <i>n</i> (%)	Range
Child sex (male)	44 (55%)	
Child age	10.5 (4.7)	3.0–17.8
Parent sex (male) (missing = 4)	16 (21%)	
Parent age	39.4 (7.8)	20.2–63.2
Parent education (above high school) (missing = 4)	46 (60%)	
Chronic medical conditions	2.8 (2.6)	0–10
Physical Health Problems Index	0.48 (0.27)	0.05–0.95
Child Global Executive Composite	53.8 (11.3)	35–79
Parent Cognitive and Affective Mindfulness	33.4 (5.1)	23–42
Parent anxiety	18.3 (6.8)	8–34
Parent depression	13.8 (6.1)	8–30

of pain scores over time, 2 linear mixed models were created with random intercept and random slope of time to control for repeated measures. Covariates adjusted for in the model included those correlated with predictor and/or outcome variables from prior literature as described earlier, confirmed in bivariate (correlational) analysis (not shown). These included baseline pain, children's age and gender, and parents' education (high school or less vs above high school). Model 1 examined how pain changed over time during hospitalization, controlling for covariates. Model 2 examined the association between pain and independent variables (chronic medical conditions, Physical Health Problems Index, Global Executive Composite, Cognitive and Affective Mindfulness Scale, PROMIS Anxiety and PROMIS Depression) individually, again adjusting for covariates. A model with all independent variables is not included in our results because of high collinearity (eg, anxiety and depression $r = 0.69$). We performed a post hoc sensitivity

higher scores indicate more emotional distress due to anxious feelings.³⁰ Parents reported on their symptoms of depression during the past week using the Patient-Reported Outcomes Measurement Information System Depression Scale (PROMIS Depression 1.0), consisting of 8 items using a 5-point response scale from

“Never” to “Almost always” (eg “In the past 7 days, I felt like a failure”); higher scores indicate more emotional distress due to depressed feelings.³⁰

Statistical Analyses

Descriptive statistics included frequency and percent, or mean \pm SD. To investigate change

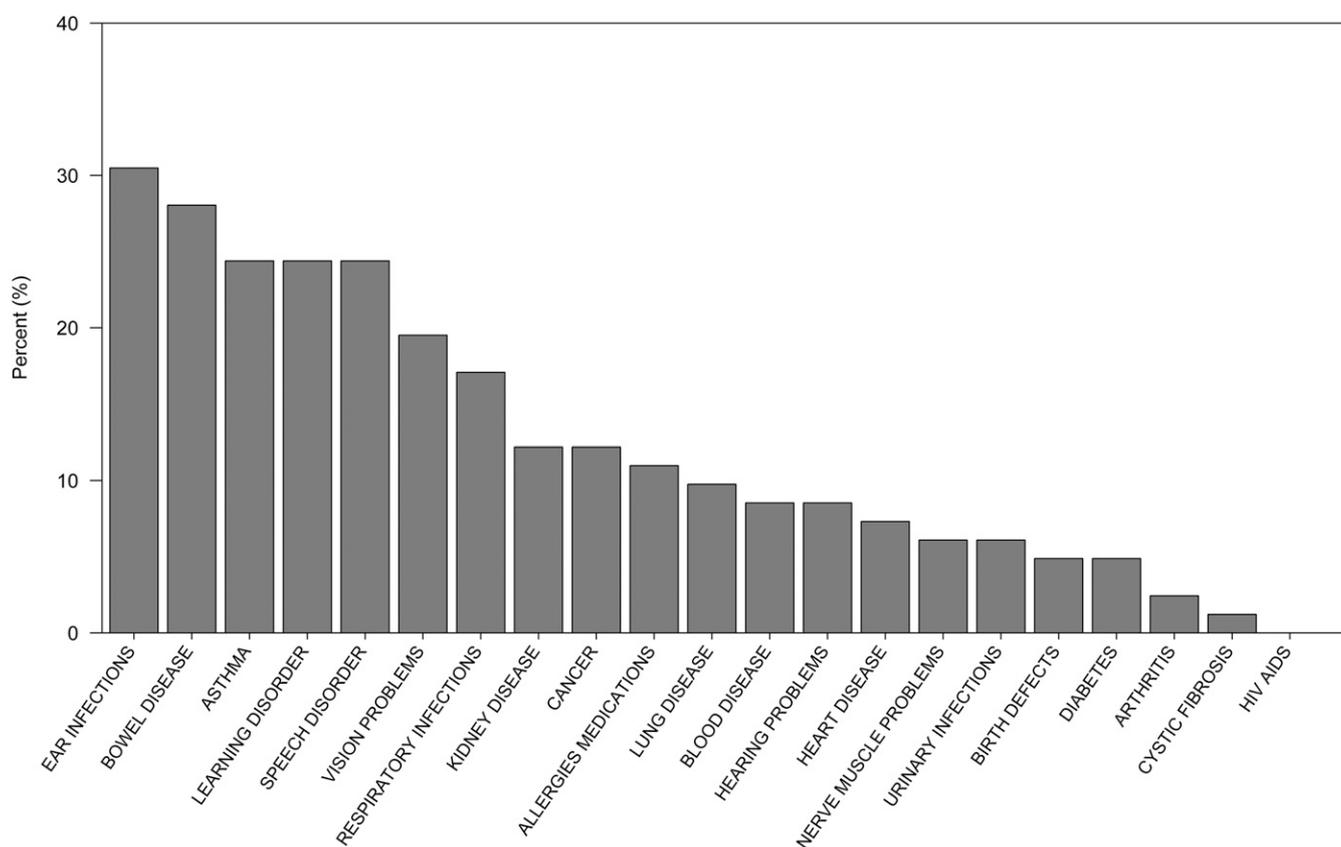


FIGURE 1 Frequency of chronic medical conditions.

analysis that excluded the most frequent chronic condition (recurrent ear infections); this demonstrated similar results to those presented for Model 2, suggesting that this highly prevalent but potentially less severe chronic condition did not impact our results. All analyses were carried out using the SAS system (v. 9.3; SAS Institute, Cary, NC). Graphs were plotted in R (<http://www.r-project.org>). All *P* values were 2-sided; those $\leq .05$ were considered statistically significant.

RESULTS

Data were analyzed and reported for 81 participants who had complete, reliable inpatient electronic medical record data for their entire hospital stay (16 were excluded due to missing, discrepant, or unreliable lengths of stay noted in the electronic medical record). The demographics of the cohort are summarized in Table 1. The majority of parents were mothers, with a mean age of 39 years and 60% having finished at least high school. Medical problems among the children in the cohort are summarized in Fig 1. The most prevalent chronic conditions (ie, those present at any time during the child's life) were recurrent ear infections, bowel diseases, and asthma, with a substantial minority reporting other oncological, cardiac, pulmonary, kidney, and neuromuscular conditions.

Children had a total of 2637 standardized pain observations over a mean length of stay of 4.2 days (median 3; range 1–25). The mean number of pain assessments per child was 5.6 per day (SD = 4.2; range 1–22). The frequency of each pain score at baseline and the time of discharge (and/or last assessment) is shown in Fig 2. The median pain score was 3.0, and the mean was 3.4 (SD 3.1; range 0–10). Fourteen children (17.3%) experienced no pain (ie, all pain scores = 0/10) during their entire hospital stay, 3.7% experienced no greater than mild pain (ie, score 1–3/10); 19.8% experienced no greater than moderate pain (4–6/10), and 59.3% experienced severe pain (7–10/10).

After adjusting for child age and gender, and parent educational status, both time ($\beta = -.23, P < .01$) and baseline pain ($\beta = .43, P < .001$) were significantly associated with pain control (Table 2: Model 1). Pain scores decreased by a mean of 0.2 U per

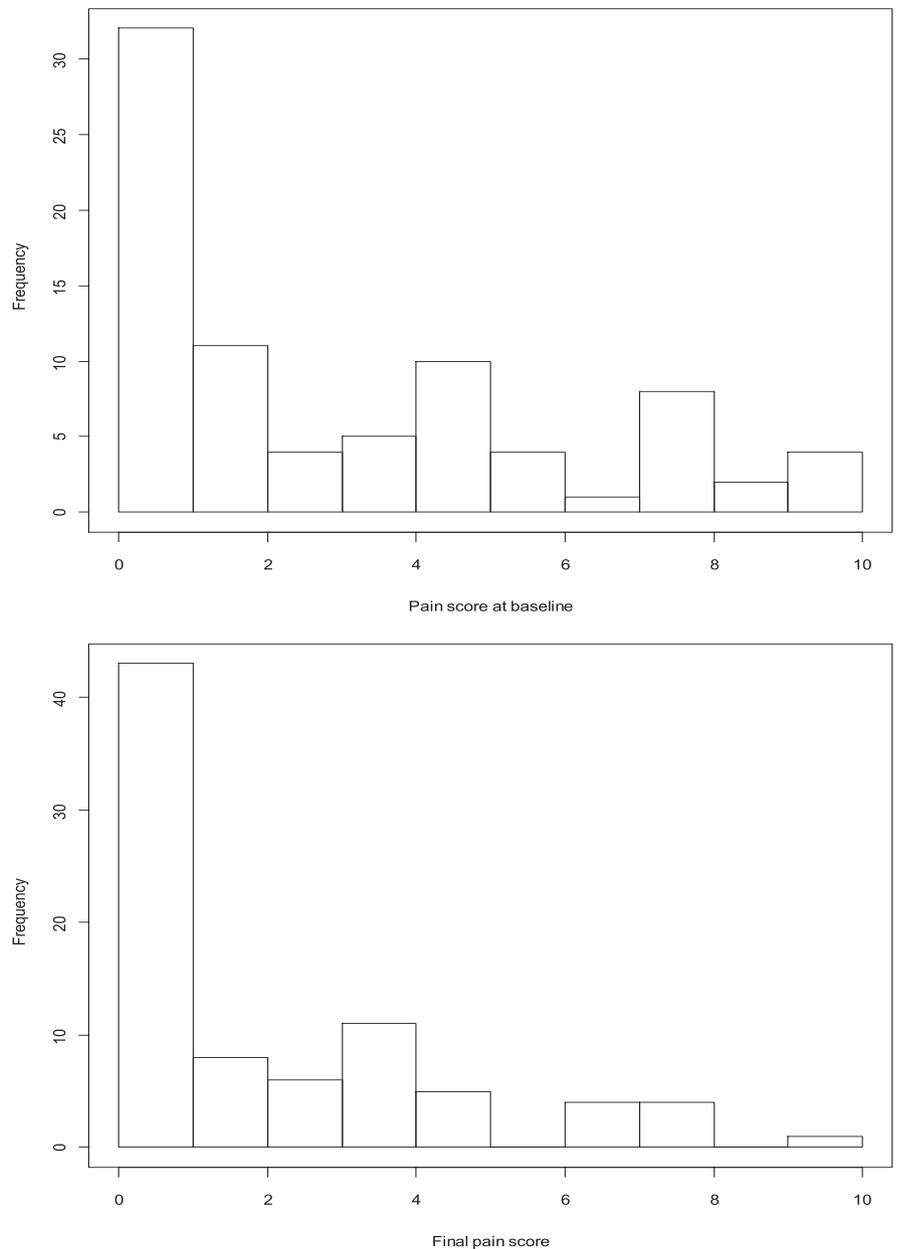


FIGURE 2 Initial (top) and final (bottom) pain scores ($n = 81$).

day. After including child and parent factors of interest in the model (Table 2: Model 2), these relationships held for pain control, time, and baseline pain. Parent anxiety and depression symptoms showed statistically significant associations with pain control (Table 2: Model 2). Pain control was not significantly associated with child age, sex, chronic medical conditions, overall health status, or executive function, nor with parent educational status or cognitive-affective mindfulness.

DISCUSSION

This prospective, cohort study reveals that parent mental health has a significant relationship with hospitalized children's pain control. Children's pain control worsened by ~1% for every 2.5% increase in parent anxiety or depression symptoms. However, 2 measures of cognitive-affective self-regulation, parent mindfulness and child executive function, did not accurately predict pain control.

TABLE 2 Estimated Effects of Child and Parent Factors on Child Pain Control

	Estimate (β)	SE	P
Model 1 ^a			
Baseline pain	0.43	0.07	<.001
Time	-0.23	0.07	.003
Child sex	0.51	0.42	.26
Child age	0.01	0.05	.37
Parent education	0.22	0.43	.60
Model 2 ^b			
No. of child chronic medical conditions	0.05	0.08	.58
Child overall physical health (PHPI)	1.20	0.80	.14
Child executive function (GEC)	0.03	0.02	.20
Parent mindfulness (CAMS)	-0.07	0.04	.12
Parent anxiety	0.11	0.03	<.001
Parent depression	0.12	0.03	<.001

CAMS, Cognitive and Affective Mindfulness Scale—Revised; GEC, Global Executive Composite; PHPI, Physical Health Problems Index.

^a Baseline pain, time, child sex, child age, and parent education were included in Model 1.

^b Adjusted for baseline pain, time, child sex, child age, and parent education; each variable was examined in Model 2 individually.

induced acute pain³⁴; however, this remains a generally understudied topic to date. The mechanisms underlying our findings could include unmeasured factors within the child (including temperament and stress reactivity), the parent-child relationship, or the hospital environment. For example, parents' emotionality plays a role in experimental paradigms of children's pain¹⁵ and in clinically referred children with chronic pain syndromes.³⁵ Likewise, children with chronic pain syndromes who tend to deal with their pain by psychologically magnifying it have more intense pain and greater disability.³⁶ Children's health status can affect parent mental health as well.³⁷ Thus, there may be bidirectional, multilevel mediators between parent mental health and pain control while in the hospital. These putative interactions remain to be investigated through future work.

Limitations of the study include the inconsistent recording of pain scores: although nurses followed the hospital's pain-monitoring protocol, they did not reliably record pain at the same frequency for each child, indicating possible selection bias. Given our observational design, we cannot control for likely between-nurse and/or between-patient variations in pain assessment methods. Furthermore, the sensitivity and specificity of the 3 pain scales used among children in this cohort are known to vary according to child- and hospital-level factors, such as child developmental status and nursing routines, that were not measured in our study.^{7,38-40} Also, the population of pediatric patients served by the tertiary care hospital in this study does not represent the entire population of hospitalized children, as shown by the high prevalence of relatively uncommon pediatric conditions, such as cancer, in this cohort. Similarly, we did not attempt to control for medical-surgical complexity, acuity, or chronicity; instead, we chose to use well-standardized, validated scales of parent-reported child health to understand pain control among a broad population of children rather than a narrowly-defined group with 1 or 2 primary diagnoses or procedures. Finally, because this was an observational study, we cannot infer causality. Our study design attempted

Most studies to date have not examined pain control longitudinally, as we aimed to do. Any analytic approach to such data must account for the fact that nurse-documented inpatient pain scores are an unbalanced, repeated measure.³¹ As expected, children's pain scores decreased with time and increased with higher levels of baseline pain. Our analytic techniques, using linear mixed modeling, are thus a valid approach to examining pediatric pain control in the inpatient setting. Furthermore, despite the heterogeneity of medical conditions in this cohort, our model did not show a significant relationship between children's physical health status or chronic medical conditions and their pain control. This strengthens the generalizability of our findings because it implies that children's pain correlates with parent emotional distress regardless of the reason for hospitalization.

Our findings also add to a growing body of evidence that hospitalized children's pain is often poorly controlled. These findings are strengthened by the use of standardized pain scores recorded in electronic medical records during children's convalescent stays on ambulatory care units, exclusive of pain recorded during procedures or in acute postoperative recovery, in emergency departments, or under intensive care. The overall distribution of pain scores in this

cohort were similar to those in other recent observational studies of pain among pediatric inpatients.⁴ For example, using electronic medical record data among 104 pediatric inpatients with a median age of 1.1 years, Friedrichsdorf and colleagues found a mean pain score of 2.9 out of 10,³² comparable to our results (3.4/10). Although only 14.4% of patients in the Friedrichsdorf et al study had severe pain as documented by their nurses, 48% experienced severe pain according to the researchers' interviews with parents, which is comparable to the prevalence of severe pain in our cohort (59%). Of note, nursing-assessed pain scores are less accurate than parent-reported pain scores in infants and toddlers and are more accurate in older children⁷; our study excluded children under age 3 for this reason, hence our higher frequency of chart-documented (nursing-assessed) severe pain.

Our findings with regard to parent anxiety and depression symptoms align well with what is known about parent mental health in the context of pediatric outpatients with functional or chronic pain syndromes.³³ Our null findings regarding parent mindfulness and child executive function/self-regulation are supported by some evidence that instructing children in guided mindful attention does not affect experimentally

to control for this to the extent possible, with parents reporting within the first day(s) of their child's hospitalization on their emotional state "for the past week" which would hypothetically predate the child's pain; however, many children in our cohort had chronic conditions and/or had other hospitalizations ≥ 1 times in the weeks and months before our study, which we did not examine in the current study.

Longitudinal research with larger samples will be needed to better understand which factors mediate and moderate the relationships between pain control and parent-child psychosocial and neurobehavioral-developmental factors. Clinically, our findings highlight the importance of monitoring parent and family emotional health in the stressful inpatient setting, implying a need to make mental health resources available to all parents as an integral part of the multimodal treatment of hospitalized children's pain.⁴¹

In summary, parent anxiety and depression symptoms are better predictors of child pain control among pediatric inpatients than several child factors, including child health status and executive function. These findings imply that parent mental health is a key component to consider when optimizing hospitalized children's pain control.

Therefore, hospital policies and procedures for pediatric pain control should also support parent well-being.

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